

## SPECIFICATION

### EVACUATED GLASS PANEL AND METHOD OF FIXING SUPPORT MEANS, DISPOSED THEREIN

#### Technical Field

The present invention relates to an evacuated glass panel and a method of fixing support means, disposed therein, particularly, a method of fixing support means, disposed therein, which is convenient to large scale production and able to increase the productivity of evacuated glass panel, and said method can employed for manufacturing high thermo and sound-insulating glass panel.

The present invention concerns the technical field of glass manufacturing

#### Background of the Art

The well-known evacuated (vacuumized) glass panel generally includes two or more planar glass sheets, due to the evacuated state between planar glass sheets, the heat can not be transferred by convection manner, and at same time a effective barrier for sound transfer is generated, such, evacuated glass panel is also referred to as high thermo and sound-insulating evacuated glass panes.

Because the evacuated state between planer glass sheets and atmospherical pressure effecting on outer surface of planar glass sheet, it is possible to cause opposite deformation of planar glass sheets in evacuated glass sheets in evacuated glass planar and even fracture of

glass sheets. Therefore, during manufactured process of evacuated glass planar, a plurality of support means, to be disposed between planar glass sheets are always used, and make the distribution of disposed support means as uniform as possible, so that to resist the atmospherical pressure on planar glass sheets, and thus maintain the shape of planar glass sheet not easy to deform and rupture.

The problem, resulted from disposing support means within the evacuated glass panel is: the influence on transmissivity of evacuated glass panel, particularly, color-less transparent evacuated glass panel, when the support means has large cross section, it not only has influence on transmissivity of evacuated glass planer, but makes it shout of a esthetic sense, therefore, a solution of said problem is to use transparent glass support means of smaller size. However, this method leads to certain difficulty in manufacturing evacuated glass panel.

In order to dispose support means between glass sheets of evacuated glass panel, an operation of placement of support means is needed. Due to support means of smaller cross section is used, so a great number of support means is necessary to place, this is true specially during manufacturing large size evacuated glass panel. At the time of placing support means, because a large number of support means is need to place, moreover, the two bottoms of support means may be not parallel, the surface of planar glass sheet commonly not very even and the height

between support means has difference, so that the support means, disposed on planar glass sheet is easy to turn down, specially, the planar glass sheet, on which support means are disposed, needs to be moved, the possibility of support means to turn down is increased.

Besides, due to the difference of height between support means, after completion of manufacturing evacuated glass panel, some support means, having lower height is able to be moved, particularly, during vertical assembling evacuated glass panel, the support means is easy to fall off under its gravity, the fall off regarding to support means leads to non-uniform support force on planar glass sheet, under atmospheric pressure, the planar glass sheet is easy to deform with receptively increased inner stress, the evacuated glass panel is trend toward fractured during accident collision, even if the force is very low. It is appreciated, from above-mentioned, the problem of turn-down and fall off regarding to support means not only exert a tremendous influence on productivity of evacuated glass panel, but also on service quality of finished evacuated glass panel, therefore, such a problem must be resolved as fast as possible.

#### Summary of the Invention

The main object of the present invention is, regarding to the problem of turn down and fall off of support means, to provide a method of fixing, support means, disposed within an evacuated glass panel, use proposed

fixing method makes small support means can be stably placed on planar glass sheet, included in said high thermo and sound-insulating glass panel, even if the planar glass sheet is moved or the finished evacuated glass panel is vertically assembled, no turn down and fall off of support means will occur so that the productivity of evacuated glass panel and quality of finished evacuated glass panel is increased.

The secondary object of the present invention is to provide a method of fixing support means, disposed within evacuated glass panel, use proposed fixing method makes manufactured evacuated glass panel obtain a specific functional layer on its inner surface, thus resulting more wide application.

The further object of the present invention is to provide an evacuated glass panel, having support means, disposed therein according to proposed fixing method, said evacuated glass panel has not only good high thermo and sound-insulation property, but also good mechanical strength and specific applicable function.

Above objects of this invention are realized through following technical schemes:

A method of fixing support means within evacuated glass panel, said evacuated glass panel includes at least two planar glass sheets, having any shape and support means, disposed therein, characterized in that said method comprising at least following steps of:

At first apply a solution layer on surface of planar glass sheet, on which the support means are disposed; secondly, place the support means on said solution layer;

At last, cover the upper surface of support means with a planar glass sheet, and heat said solution layer to dry, so as to fix said support means between planar glass sheets. Said solution layer entirely or partly covers or locates planar glass sheet's surface, on which the support means is disposed in order to manufacturing evacuated glass panel, having various specific function. Said planar glass sheet, on which support means is disposed, is a top planar glass sheet or a intermediate planar glass sheet. Said heating method is a oven drying or sintering.

An evacuated glass panel according to this invention, comprising: a top planar glass sheet, a bottom planar glass sheet, support means and seal component around the periphery of planar glass sheet, characterized in that, said support and bottom planar glass sheets; said support means are adhered to the surface of bottom planar glass sheet through residual solution layer; the cavity between top and bottom planar glass sheets is a evacuated space. Said support means is solid or hollow pillar said hollow pillar has opened penetrated portion at its side or top surface, for communication of space between planar glass sheets with the inner cavity of hollow pillar. Said support means is more than two on top planar glass sheet, and uniformly disposed on surface of bottom planar glass sheet or

on upper surface of top planar glass sheet.

Said residual solution layer is an adherent layer formed after volatilization of organic or non-organic solution during glass manufacturing process; said adherent layer entirely or partly covers or locates the surface of bottom planar glass sheet or upper surface of top planar glass sheet. Said sealing component is used to vertically seal and join to edge frame component around the periphery of planar glass sheet; said edge frame component will through sintering melt the low melting point glass powders, applied on its inner side, and after cooling seal and join to the periphery of said planar glass sheet.

With regard to shortages of prior evacuated glass panel, the present invention proposes: a method of placing the support means on surface of planar glass sheet through adhesion at the process of glass manufacturing, using said method, it can maintain uniform force receiving of planar glass sheet on one hand, and resolve problem of movement of support means within evacuated glass panel on other hand, resulting a good quality level for the evacuated glass panel. The present invention has following advantages:

Using said method for placing support means in evacuated glass panel, because the immersion and surface tension effect of liquid, the support means can not be moved at successive operations, so as to simplify operation, reduce cost and increase operating effectiveness.

using said method for placing support means in evacuated glass, through heating operation in manufacturing process of evacuated glass panel, due to presence of residual matter of organic solution, as well as non-volatilizable matter of non-organic material, specially, at periphery around the end of support means, due to surface tension of liquid, the residual matter is collected relatively more, therefore, said method has following advantages: because the hardness of residual matter is far lower than that of support means or glass, so a buffering layer is formed, thereby increasing the mechanical strength of evacuated glass panel and overcoming the problem identified by non-uniform stress due to the difference of support means, generated in compression process of evacuated glass panel; the residual matter adheres support means and planar glass sheets together, without occurrence of movement of support means; if solution material having higher infrared reflecting ability is used, the manufactured glass panel will be effective to reduce thermal conductivity. Using high thermo and sound insulating evacuated glass panel made by said method, overcomes the disadvantage due to difference of support means and movement thereof, thereby increasing the mechanical strength and practical applicability of evacuated glass panel

#### Brief Description of the Drawing

Fig.1 is a schematic cross sectional view of an embodiment with covered

rosin spirit solution layer according to this invention;

Fig.2 is a schematic cross sectional view of embodiment in Fig.1 after completion of manufacture;

Fig.3 is a schematic cross sectional view of an embodiment having three planar glass sheets with covered solution layer according to this invention;

Fig.4 is a schematic cross sectional view of embodiment in Fig3 after completion of manufacture; Fig.5 is schematic cross sectional view of an embodiment with tin chloride solution; Fig.6 is a schematic cross sectional view of embodiment in Fig.5 after completion of manufacture.

#### Best Mode for Carrying Out the Invention

The present invention will be described in more detail by way of embodiment with reference to accompanying drawings as follows.

#### Example 1:

As shown in Fig 1 this embodiment according to the present invention uses a rosin spirit solution for adhering support means. The evacuated glass panel comprising: a top planar glass sheet1 and a bottom planar glass sheet 2; at surface of bottom planar glass sheet 2 a layer of organic rosin spirit solution 5 is entirely rolled on; between two planar glass sheets support means 4 is in form of transparent glass pillar with penetrated hole 41; at periphery around planar glass sheet a glass seal component 6 is placed. The manufactured process of said evacuated glass



panel including following steps:

At first apply a layer of organic rosin spirit solution on surface of bottom planar glass sheet 2 by way of entirely rolled on, secondly, uniformly place support means 4 as required on surface of bottom planar glass sheet 2, due to the immersion and surface of bottom planar glass sheet 2, due to the immersion and surface tension effect of liquid the support means 4 is not easy to be moved. As show in Fig2, at successive operations of evacuated glass manufacture, a glass seal component 6 is sealed and joined on periphery around planar glass sheets through sintering. At the end of said manufacturer process, because higher temperature of seal and join (i.e.  $400^{\circ}\text{C}$ ), the rosin spirit solution 5 is dried, moreover, during evacuation of air from intermediate layers between planar glass sheets, the volatilized vapor of rosin spirit solution is bled out by evacuation. Because rosin spirit solution 5 is able to leave a residual layer 7 at process of drying, specially, at periphery around the end of support means 4 due to surface tension of liquid, the residual matter is collected relatively more.

Moreover, because the hardness of residual layer 7 is far lower than that of support means or glass, so a buffering layer is formed, thereby increasing the mechanical strength of evacuated glass panel and overcoming the problem identified by non-uniform stress in glass resulted from difference of support means 4 in compression process of evacuated

glass support means and planar glass sheets together, without occurrence of movement of support means 4.

Example 2:

As shown in Fig 3,4 this embodiment according to the present invention use a solution layer for adhering support means in manufacturing a vacuum glass panel, having 3 planar glass sheets.

The hollow three-layer evacuated glass panel comprising: top planar glass sheet 3, bottom planar glass sheet 2a; at upper surfaces of intermediated planar glass sheet 3 and bottom planar glass sheet 2a a layer of indium oxide water solution 5a is entirely rolled on, between three layer of planar glass sheets solid main support means 4a are disposed, at periphery around planar glass sheet a glass seal component 6a is placed.

The manufacture process of said evacuated glass panel including following steps:

At first apply a layer of indium oxide solution 5a on surface of bottom planar glass sheet 2a by way of entirely rolled on, secondly, place support means 4a as required on surface of immediate planar glass sheet 3 and bottom planar glass sheet 2a above the solution layer 5a, at last, slightly compress said three layers of planar glass sheets and carry out successive sintering operation.

In said embodiment, the effect of indium oxide solution is similar to

that of organic rosin spirit solution in example 1, after sintering the residual layer 7a gives a good adhering effect on support means 4a. During production or practical assembly, the support means cannot be moved or fall off.

Evacuated glass panel made by this method has good operational performance.

### Example 3:

As shown in Fig 5,6, this embodiment according to the present invention use a tin chloride solution layer for adhering support means. Said embodiment is an evacuated glass panel, comprising top planar glass sheet 1b and bottom planar glass sheet 2b; the upper surface of bottom planar glass sheet 2b is entirely covered by a layer of tin chloride solution 5b; between two planar glass sheets a support means 4b is disposed; said support means 4b is a hollow glass pillar 4b with penetrated notch 41b, through said penetrated notch the space between planar glass sheets is communicated with inner cavity of support means, thereby ensuring evacuated state within support means after evacuation of space between planar glass sheets. At periphery around planer a glass sheet metal seal component 6b is disposed, during sintering process, the low melting point glass powder on inner side of metal seal component 6b is melted and after solidified on inner portion around the periphery of said metal seal component 6b and planar glass sheet, realizing the sealing of evacuated

glass panel. In said glass manufacture process the effect of tin chloride solution is similar to that of above example 1, further description is omitted, it should be noted, that after sintering operation the layer of tin chloride solution 5b became a residual layer of tin chloride 6c, said residual layer of tin chloride 6c in addition to adhering and fixing effect, covers surface of bottom planar glass sheet 2b.

Because good infrared reflecting and electric conducting effect of residual tin oxide layer 6c, leading to effective reduction of thermo conductivity of glass, said two layer evacuated glass panel after evacuation will have better high thermo and sound-insulating ability, as well as good electric conductivity, and thereby a wide application. At last, it should be noted, that above-mentioned embodiments are employed only for description of the technical schemes of the present invention and should not be limited thereon, although the present invention has been detailed described, it should be apparent to those of ordinary skilled in the art that modifications and variations may be made without departing from the spirit and scope of the technical schemes of the present invention, all they should be included within the scope of appended claims.